Nuclear Science Division Newsletter

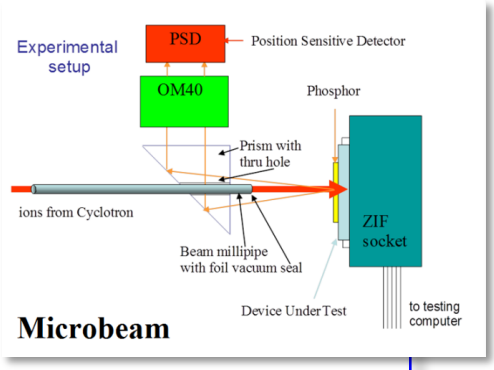
In this issue: **December 2011/January 2012**

88-Inch Cyclotron supports a broad base

The Berkeley Accelerator Space Effects (BASE) Facility, at the 88-Inch Cyclotron, has expanded its capabilities in support U.S. space programs, including those for national security. During the 1990s, the use of the 88-Inch Cyclotron for radiation effects testing and research increased to nearly 20%. In 2004, the United States Air Force (USAF) and National Reconnaissance Office (NRO) began partial support of the 88-Inch operating budget. By 2005, the Department of Energy, USAF, and NRO signed a memorandum of agreement to continue joint funding of the Cyclotron through 2010. In 2011, this agreement was renewed through 2015.

The BASE Facility provides an assortment of beams, including heavy ion "cocktails," where multiple ions are simultaneously injected in to the Cyclotron. These are selected and separated by simply changing the Cyclotron frequency. This allows for rapid beam changes, typically within a few minutes. The cocktail beams are used to investigate single event effects by correlating event cross sections with the linear energy transfer. Protons from 1-55 MeV and 8-30 MeV neutrons are available, providing a convenient one-stop facility for radiation effects research.

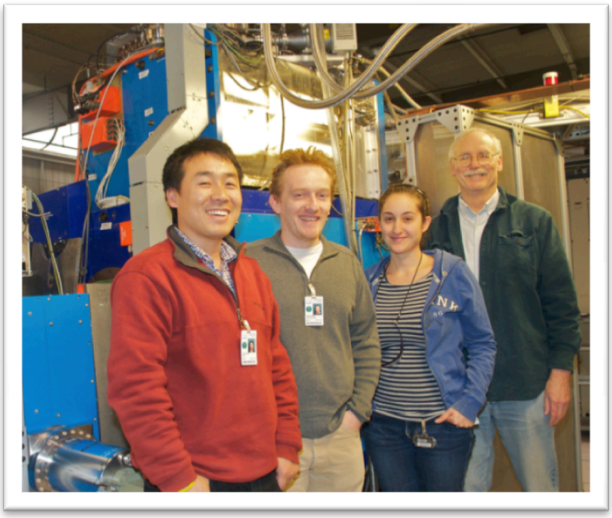
As semiconductors have grown smaller, new failure modes have appeared. Responding to the needs of researchers, two parallel efforts are underway at the BASE Facility. The "Milli-Beam," is a diffuse, high-intensity parallel beam collimated with precision slits. It has achieved beam spots of 20 microns in size. The "Microbeam," (right), is the result of collaboration with Sandia Labs. It creates an optical reconstruction of a very low intensity beam, and has achieved 5-micron resolution.



Over the last few years, BASE has assisted in a wide range of research, from the testing of local Nuclear Science Division experimental parts to spacecraft materials to potential cancer treatments. The BASE Facility has also conducted tests for ATLAS detectors, the Orion spacecraft, astronaut dosimetry, and numerous NASA missions, including the Lunar Reconnaissance Orbiter, Solar Stereo, the Solar Dynamics Observatory, and the Radiation Belt Storm Probes, which is set to launch next year. With these improvements and the extension of the operating agreement, the BASE Facility is strategically positioned for an exciting future.

VENUS shines more brightly

The superconducting Electron Cyclotron Resonance (ECR) ion source, VENUS, produced record levels of high charge state uranium on 11/16/2011. The VENUS source provides intense high charge state ions for the LBLN 88-Inch Cyclotron programs and serves as an R&D ECR ion source for future heavy-ion accelerators. The tests on uranium beams are being done to support the planned Facility for Rare Ion Beams (FRIB) project now under design at Michigan State University. Two MSU scientists, Guillaume Machicoane and Lianting Sun participated with Janilee Benitez and Claude Lyneis from the 88-Inch Cyclotron ECR ion source group in the tests.



L-R: Lianting Sun, Guillaume Machicoane, Janilee Benitez, and Claude Lyneis

The key result was the production of 440 eμA of U^{33+}, which more than doubled the previous world record of 205 eμA set by VENUS in 2006. The new result could provide sufficient beam for the FRIB heavy ion driver to meet its design goal of 400 kW of uranium beam power without needing to use a complex two-charge state injection system. The results also demonstrated for the first time that the ECR plasma produced at 28 GHz can produce the needed uranium plasma density and that the LBNL designed rhenium oven can supply the needed vapor density at about 2000 degree C within the hostile conditions existing in the ECR plasma chamber. Further gains in the performance should be possible since these results were obtained during after only tuning for about 12 hours. The VENUS extraction system has also been redesigned and will be modified in the next months with the goal in increasing the extraction voltage from 22 to 30 kV, which should improve the beam transport efficiency for intense beams.

Uranium ion	Beam current in eμA
28^+	295
29^+	361
31^+	460
32^+	453
33^+	443
34^+	400
35^+	311

High charge state performance of Venus with uranium.

Further development of oven technology will be needed to meet the long-term production and beam stability needed for regular operation of FRIB, which is targeted to begin in 2018 at Michigan State University.

NSD hosts KATRIN Analysis Software Workshop

NSD welcomed a week-long KATRIN analysis software workshop from December 5 to 9, 2011. About 20 participants from the US and Germany engaged in lively sessions to discuss analysis issues for the commissioning of the KATRIN experiment, which can probe the neutrino mass scale with a sensitivity of 200 meV. The KATRIN group at LBNL leads the analysis software development in the experiment.

Celebrating Women in Nuclear Science

2011 marks the 100th anniversary of Marie Curie's Nobel Prize in Physics – the first such prize to go to a woman. NSD's Darleane Hoffman has been active in recognizing this important anniversary, and, more generally, the role of women in physics. In November 2011, she presented an invited lecture at the "Marie Curie Symposium: Nuclear Sciences – Past, Present and Future," in Oslo, Norway. There, she shared the stage with Helene Langevin Joliot (IPNO), who is Marie's granddaughter; her parents, Irene Curie and Frederick Joliot shared the 1935 Nobel Prize in Chemistry. Hoffman also co-organized the American Chemical Society "Marie Curie Symposium" at their August 29-September 1 national meeting in Denver.

NSD Fragments

Prof. Gabriel Orebi-Gann has joined the Nuclear Science Division and UC Berkeley, as a joint appointment. Her primary experimental interest is in the SNO+ neutrino experiment, the successor to the extremely successful SNO experiment. SNO+ will search for neutrinoless double beta decay by loading an organic scintillator target with ^{150}Nd. It will also study solar, reactor and geo-neutrinos, and, potentially supernova neutrinos. Gabriel is also involved in the DEAP/CLEAN dark matter programme, a single-phase liquid noble gas approach to dark matter detection.

Alan Poon will begin his three-year term as a member of the American Physical Society's Committee on Education in January 2012. Since the beginning of 2011, he has been serving as a member of the Advisory Council of the Community Resources for Science, a Berkeley-based non-profit organization that provides resources and support to science teaching at elementary schools in the Bay Area.

Newsletter Notes

Please send any comments, including story suggestions to Spencer Klein at: srklein@lbl.gov

Previous issues of the newsletter are available at:
https://commons.lbl.gov/display/nsd/NSD+Newsletter